Inventory & Monitoring
Pacific Island Network

National Park Service
U.S. Department of the Interior

Pacific Island Network Quarterly

Meet IRMA

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National Park Service
U.S. Department of the Interior
Pacific Island Network
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The National Park Service (NPS) has implemented natural resource inventory and monitoring on a servicewide basis to ensure all park units possess the resource information needed for effective, science-based management, decision-making, and resource protection.

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NOTE: Unless indicated all photos and articles are NPS.

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Field Schedule

	July	August	September
Landbird monitoring	HALE		
Invasive plants	HALE	HALE	HALE
Vegetation communities	HALE	KALA, HALE	KALA, HALE
Water quality	HALE, KAHO	KALA, PUHE, PUHO, ALKA, WAPA, AMME	NPSA
Stream animals	WAPA, HALE	KALA	NPSA
Ground water		AMME, KAHO	
Benthic marine	KALA, WAPA	KALA	
Marine fish	KALA, WAPA	KALA	
Vegetation mapping	NPSA	NPSA	
Climate (on-going)	All Parks ----------		

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- From any NPS computer simply type in your web browser:
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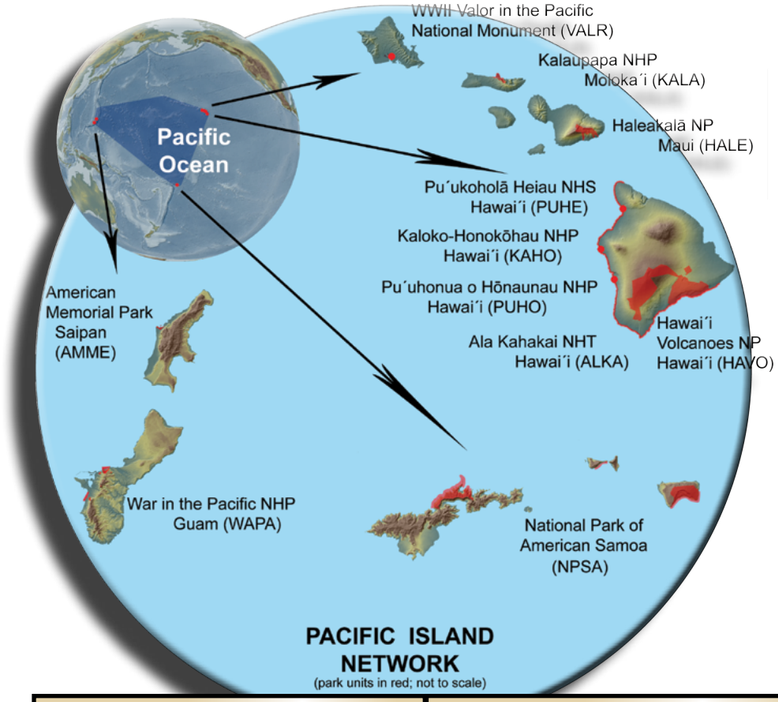


Interactive graphic: http://science.nature.nps.gov/im/units/pacn/monitoring/vital_signs.cfm

Tamiligi Slain

For much of the past decade, the National Park of American Samoa has devoted considerable effort to eradicating invasive tamiligi trees (*F. moluccana*) with a field team affectionately known as the "Tamiligi Slayers." All too often management efforts like these yield mixed results. Not this time !

A joint NPS and USDA Forest Service study led by Dr. F. Hughes, reports a successful tamiligi removal project where the affected native forests recovered splendidly. Once tamiligi (a.k.a. albezia) is removed, native tree species take advantage of increased tamiligi-converted nitrogen in the soil and access to sunlight. Moreover, after 3 years, tamiligi seedlings stopped re-emerging from the young native forests. The tamiligi at NPSA appear to be successfully slain.

Guam Corals Workshop

Just as Guam's teachers were settling into summer break, the I&M Program joined with War in the Pacific NHP and Univ. of Maryland Center for Environmental Science (UMCES) to hold a full week "teach the teachers" workshop with a few dozen local science teachers. The workshop encouraged Guam teachers to use NPS and UMCES developed coral reefs and climate change science material in their classrooms. How did they like it?

"*I cannot wait to put* [the program] *to use in my classroom and share with my other colleagues.*"
—9th grade teacher

"*I never realized the importance of our coral reef. It is an important part of our lives.*" —Elementary teacher

Educational Module Link

Featured Staff

David Raikow joins PACN I&M as the new aquatic ecologist. "Moving away from Cincinnati was my family's chance to see the big parks. We drove to Grand Canyon, Yellowstone, Yosemite, and many monuments. It's important to me that my kids experience great places." Most recently, Dave was an ecologist for the Environmental Protection Agency working on contaminants. Prior to that he was a biologist for the National Oceanic and Atmospheric Administration in Ann Arbor, MI working on biological invasion. He grew up in Pittsburgh, and hereby proclaims Volcano Village to be *Steeler Country*. But having been born in Honolulu, he's really returning to his roots. "My father studied the evolutionary origin of Hawaiian honeycreepers based on muscle morphology in the late 1960's. I'm proud to contribute to the stewardship of the islands' natural resources."

Happy trails to I&M Biological technicians **Corie Yanger, Koa Awong, and Kim Tice**. Thanks for your contributions to the program.

Marine Fish
Kalaupapa National Historical Park *2006-2010 data*

Background

Kalaupapa National Historical Park is located on the north shore of the island of Moloka'i in Hawaii. The park encompasses a wide variety of habitats from submerged marine resources to lowland coastal, mesic, and rainforest habitats as well as three offshore islands. The marine boundary of the park extends a quarter mile offshore around the park shoreline and encompasses approximately 2,000 acres.

The objective of the marine fish monitoring protocol is to annually determine the density and size of reef fishes along both random and fixed sites at a depth of 10 to 20 meters. A total of 30 transects (sites) are sampled each year. The 15 fixed transects were originally surveyed in 2006, and are resurveyed every year. The remaining 15 temporary transects are randomly selected each year and surveyed only in that year. Data collection consists of visual counts, species identification, and size estimations of all fish encountered within the thirty 25 x 5 meter belt transects. Scientific divers conduct this non-destructive survey technique and focus on the day-active fish species that are highly visible due to their typically bright coloration and generally large size. This report includes the status of the fish populations at all 30 transects in 2010, and trends along the 15 fixed transects from 2006-2010.

Results *2010*

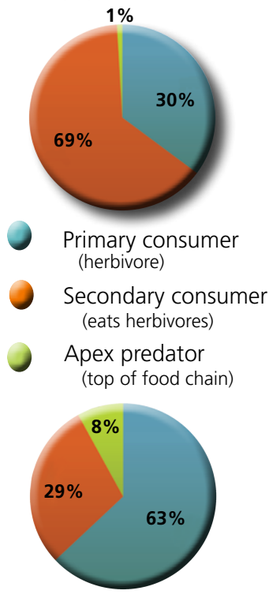
Species	Common (Hawaii) Name	Consumer Group	Density*
Chromis vanderbilti	Blackfin chromis (unknown)	Secondary	15.50
Acanthurus leucopareius	Whitebar surgeonfish (māikoiko)	Primary	2.97
Kyphosus spp.	Rudderfish (nenue)	Primary	2.72
Paracirrhites arcatus	Arc-eye hawkfish (piliko'a)	Secondary	1.78
Acanthurus triostegus	Convict surgeonfish (manini)	Primary	1.70
Thalassoma duperrey	Saddle wrasse (hinālea lauwili)	Secondary	1.49
Acanthurus nigrofuscus	Brown surgeonfish (mā'i'i'i)	Primary	1.33
Ctenochaetus strigosus	Goldring surgeonfish (kole)	Secondary	1.06
Chromis ovalis	Oval chromis (unknown)	Secondary	0.68
Acanthurus olivaceus	Orangeband surgeonfish (na'ena'e)	Primary	0.54

Top ten fish species by density (no./m²)*

Top ten fish species by biomass (metric ton/km²)**

Species	Common (Hawaii) Name	Consumer Group	Biomass**
Kyphosus spp.	Rudderfish (nenue)	Primary	1969.56
Acanthurus leucopareius	Whitebar surgeonfish (māikoiko)	Primary	514.92
Bodianus bilunalatus	Hawaiian hogfish ('a'awa)	Secondary	468.81
Naso lituratus	Orangespine unicornfish (umaumalei)	Primary	336.55
Acanthurus olivaceus	Orangeband surgeonfish (na'ena'e)	Primary	331.40
Caranx melampygus	Bluefin trevally ('ōmilu)	Apex	272.15
Lutjanus kasmira	Bluestripe snapper (ta'ape)	Secondary	183.82
Cephalopholis argus	Peacock grouper (roi)	Apex	170.19
Ctenochaetus strigosus	Goldring surgeonfish (kole)	Secondary	168.03
Naso hexacanthus	Sleek unicornfish (kala lōlō)	Secondary	145.60

Relative density of fish consumer groups at Kalaupapa NHP in 2010.



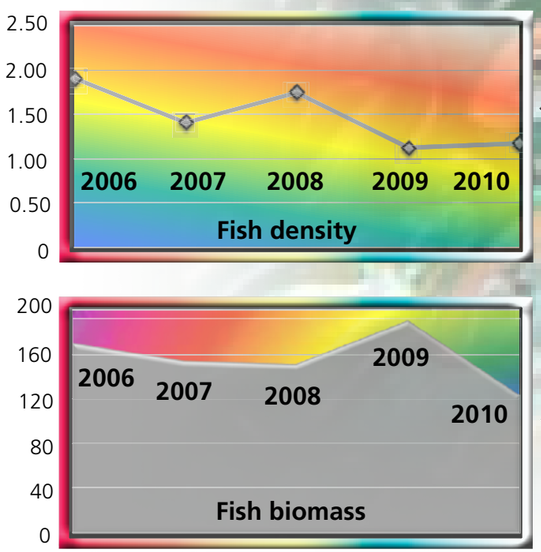
Relative biomass of fish consumer groups at Kalaupapa NHP in 2010.

Summary Points

- Fish species richness (the number of fish species detected) ranged from 12 to 38 species per transect. Transects with high and low species richness and diversity were distributed fairly evenly throughout the park.
- The density of fish at all transects generally ranged from 0.29 to 3.26 fish/m². Transects with the highest fish densities were concentrated along the northwestern coast of the peninsula.
- The secondary consumer, blackfin chromis, was by far the most abundant species found at Kalaupapa. It was more than five times as abundant as the next most common species in the park, the primary consumer, whitebar surgeonfish.
- Secondary consumers accounted for approximately 69% of the individual fish observed, while apex predators accounted for 1%, with primary consumers making up the remaining 30%.
- In contrast, the relative biomass of secondary consumers was 29%, compared to 8% for apex predators, and 63% for primary consumers.
- Fish biomass ranged between 44.5 and 469.0 metric tons/km² on all but two transects.
- The bulk of the biomass was accounted for by the third most common species found in the park, the primary consumer, rudderfish. Rudderfish accounted for almost four times the biomass as the second most abundant species by biomass, the whitebar surgeonfish.

Observations 2006 – 2010

The fish assemblage at Kalaupapa NHP appears healthy and robust compared to other nearshore areas in the main Hawaiian Islands.



Mean fish density has declined since monitoring was initiated. In 2006, mean fish density was 1.91 fish/m², while in 2010 that number had fallen to 1.18 fish/m².

Mean fish diversity was stable from 2006-2008, but increased slightly in 2009 and 2010.

Mean fish species richness remained relatively stable (approximately 24 species per transect).

Mean fish biomass remained relatively stable between 2006 and 2009 (approximately 166 metric tons/km²), but a slight decline was observed in 2010 (to 123 mt/km²).

Download the full Kalaupapa NHP Marine Fish Monitoring Program Annual Status Report for 2010

Climate
Nine Pacific Island National Park Units *2010 data*

Background

Climate and weather influence every aspect of ecosystem health. For example, warmer ocean temperatures affect coral growth, and therefore, whole reef ecosystems. Climate/weather variations affect how invasive species spread, and influence the composition of terrestrial plant communities. Precipitation directly impacts groundwater dynamics, freshwater animals, and water quality. Insects are affected by changes in temperature, precipitation, and seasons which, in turn, affect bird communities. In short, climate affects everything. The primary goal of climate monitoring is to determine the status and trends of weather patterns and long-term climate regimes so managers can make informed decisions about resources.

Climate is generally mild on equatorial Pacific islands. Weather patterns in the national parks are largely controlled by island topography and events like El Niño/La Niña Southern Oscillation. Two seasons prevail in Hawaii; the April through October dry season, and the November through March wet season. The wet season in American Samoa is from October through April and from July through November in the Marianas (Saipan and Guam).

In 2010, data was collected from 18 weather stations in or near parks across the Pacific Island Network. Many of the national park units in the Pacific islands contain multiple and various types of weather stations (COOP and/or RAWS stations). These stations take different measurements but are becoming increasingly standardized as the National Park Service installs new and replaces older models. Although weather measurements are not consistent among all parks, data collection and integration is improving each year. Measured variables typically include temperature, precipitation, wind speed and direction, humidity, solar radiation, barometric pressure, fuel temperature, and fuel moisture.

Summary Points

- The 2010 October through April wet season in Hawaii was the driest in 30 years. The northern area of Kohala on the Big Island was classified in the exceptional drought category; the first time any area in the state has been classified as such.
- Most parks in the Pacific Island Network were substantially drier and somewhat cooler than normal with the exception of the National Park of American Samoa. American Memorial Park and War in the Pacific National Historical Park were also drier, but slightly warmer than normal.
- Rainfall and temperature data for the islands in the PACN showed strong El Niño conditions until April 2010 with a transition to La Niña conditions as spring progressed.
- In Hawaii, late wet season rain fell at nearly normal monthly rates and abated drought conditions in most areas. A record single-day rainfall total of 5.41 inches fell at the Honolulu International Airport on Sunday, December 19th, breaking the old record of 5.28 inches set in 1955. This one day event pushed the annual total much closer to normal conditions.
- The number of tropical cyclones in the North Pacific Basin during 2010 was far fewer than has ever been recorded, making 2010 a very remarkable year.

Results by National Park

There can be substantial differences between weather variables among stations in any given park. Temperatures, winds, and precipitation measured on top of a mountain, for example, will vary considerably from measurements taken at sea level. Generalized and condensed weather data on a park by park basis is presented in the table below.

National Park	Precipitation	Temperature	Notes
American Memorial Park	69%	Less than 1°F warmer	
Haleakalā National Park	48% - 67%	Less than 1°F cooler	A March tropical depression brought rain, but not enough to reverse the year's drought trend
Hawai'i Volcanoes National Park	17% - 46%	3° - 12°F cooler*	The 17% precipitation and 12°F cooler temperature data were recorded at the Mauna Loa Observatory station
Kalaupapa National Historical Park	71%	Less than 1°F cooler	Strong winds from the N and NE dominated in Jan. - Feb., and strong E winds prevailed the rest of the year
Kaloko-Honokōhau National Historical Park	84%	Less than 1°F cooler	Appears to be the park in Hawaii with the closest to normal conditions
Pu'uhonua o Hōnaunau National Historical Park	62%	N/A	Temperature data will be collected at the park beginning in 2012
Pu'ukoholā Heiau National Historic Site	56%	Less than 1°F cooler	Very dry all year with the exception of a slighter wetter Nov. and Dec.
National Park of American Samoa	109%	1°F - 2°F warmer	The only park to record wetter and up to 2°F warmer conditions
War in the Pacific National Historical Park	30% - 85%	1°F warmer	The Agat weather station received only 30% of normal rainfall with no rain from Aug. - Sept.

This table approximates the average temperature and precipitation for all of the weather stations in each park. These figures compare 2010 data with long-term "normal" conditions derived from historical data. Therefore, "69%" preciptation and "Less than 1°F warmer" temperature were the 2010 weather conditions as compared to the long-term average conditions for that park unit.
*The 3°F cooler average temperature was taken from three lower elevation stations, whereas the 12°F cooler average was recorded at the summit of Mauna Loa.

The Weather/Climate Data Summary 2010 is a snapshot in time of weather data. After decades of similar weather data are collected and compared to weather data from both NPS and partner agencies on the islands, a long-term trend in climate pattern changes can be established for the national park units. Understanding how climate is changing helps National Park Service managers to adapt strategies for managing natural and cultural resources of all of the parks in the Pacific Island Network.

For the full report on weather patterns and data from individual weather stations, download:
Annual Weather/Climate Data Summary 2010

Between the Trees and the Peak

Invasive plants in the subalpine shrublands of Hawai'i Volcanoes N.P.

Often marginalized when compared to Hawaii's lush forests or spectacular coastlines; above the iconic koa and ʻōhiʻa trees lies the subalpine shrublands. For rare and endangered Hawaiian plants, the cool and relatively dry climate above the trade wind inversion layer (the cloud layer often seen on Hawaiian mountains) is what makes this community special. But the native species are not alone on these high slopes. Although the subalpine vegetation spanning the Kahuku and Mauna Loa Strip areas of the park has seen minimal disturbance compared to lowland areas, invasive nonnative plants still present a real threat. To make matters worse, climate change is predicted to alter the inversion layer resulting in potentially adverse conditions for these native plant communities.

Despite a long history of plant management in Hawai'i Volcanoes National Park, few studies have focused on the difficult-to-access subalpine shrublands. The early detection of nonnative plants in this area is essential. It allows the park to target invasions at their initial stages, thus reducing future ecological and monetary costs.

In 2011, the Inventory & Monitoring Program surveyed 20 transects (5 m x 500 m each) for invasive nonnative plants in four subalpine zones: northwest Kahuku, interior & west Kahuku, above the Kaʻū Forest, and along the Mauna Loa Strip.

All of the nonnative species detected were herbs or grasses. Over half (65%) of the transects sampled contained at least one nonnative species, but no single nonnative species dominated more than one percent of any transect. This is a good sign that the native plant communities are still intact.

The greatest number of different nonnative species were found in NW Kahuku (37 nonnative species/transect), and fewest were detected in the Mauna Loa Strip zone (1 species/transect). Not surprisingly, NW Kahuku also had the most land covered by nonnative species among the four surveyed zones. This is likely due to the abundance of weed-spreading feral sheep and goats.

Every five years, an Inventory & Monitoring Program team will again ascend to the subalpine shrublands of Hawai'i Volcanoes National Park to assess how the invasive nonnative species are changing, and provide these data to park managers.

Although sometimes forgotten among the rain forests and lava fields of Hawaii, the subalpine shrubland community remains a relatively intact bastion of native plants. Let's keep it that way.

–M. Simon, NPS
Biological technician
–C. Nash, NPS
Science communications

Biological technician Laura Arnold inspects *Rumex acetosella*, an invasive plant also known as sheep sorrel. Overall, the frequency of encountering sheep sorrel in the subalpine shrubland was relatively low. In the Northwest Kahuku zone, however, sheep sorrel was one of the most frequently recurring invasive species; present in 88% of the transect segments. Some animals graze on this plant for food and consequently disperse seeds after they pass through the animals' digestive systems. Sheep sorrel seeds also spread via wind and water, and the plant can reproduce by cloning through its horizontally creeping rhizomes.

Background: native ʻaʻaliʻi (*Dodonaea viscosa*) in the subalpine shrubland.